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Sigmira Software and the RTL_SDR USB Dongle

In a departure from our usual Carrying on the Practical Way articles, Phil Davidson G0DOR uses an off-the-shelf solution to create a wideband receiver for a very modest outlay.

Fig 1: The RTL-SDR Dongle as advertised on the CosyCave website.

Research in the 1970s defined a possible scheme for a digital receiver. Later research employed advances in digital techniques and computing power to replace hardware with software applications. Hardware such as mixers, filters, amplifiers, modulators/demodulators and detectors are implemented by computer software. Among other software defined radio solutions, this research led to the development of the 'receiver on a stick' that we now know as an SDR USB device. SDR USB device come in a variety of guises, including the popular FUNcube dongle developed specifically for amateur satellite purposes. Here, though, I focus on the cheapest solution of all, the RTL-SDR dongle, offering wideband reception for very little outlay.

Fig. 2: An internal board view of an RTL-SDR.

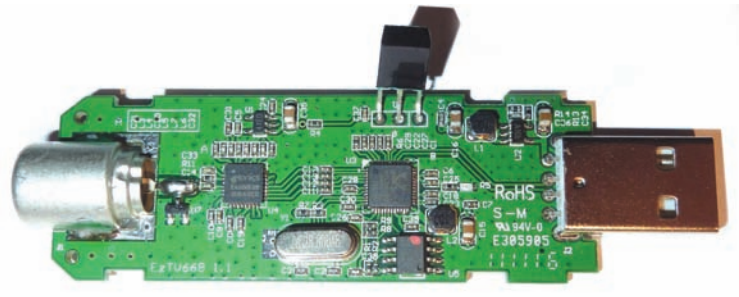

Fig. 3: Another internal view, from a different manufacturer.

What is RTL-SDR?

The RTL-SDR USB device is an inexpensive software defined radio (SDR) that uses a DVB-T TV (Digital Video Broadcasting — Terrestrial) tuner dongle based on the RTL2832U chipset originally developed for digital TV reception.

According to the RTL-SDR website, below, with the combined efforts of **Antti Palosaari**, **Eric Fry** and Osmocom it was found that the signal I/Q data could be accessed directly, which allowed the DVB-T TV tuner to be converted into a wideband software defined radio via a new software driver.

www.rtl-sdr.com/about-rtl-sdr

You'll often see reference to I/Q data and I/Q outputs in articles about SDR equipment. Put simply, I/Q data relates to the amplitude and phase of a sine wave. This isn't the place to go into a lot of detail about how this data can be used in signal processing but the website below is a useful reference if you want to read further.

www.ni.com/tutorial/4805/en

What it all means for you and I, though, is that a £10 TV tuner dongle with the RTL2832U chip can be used as a computer based, broadband radio receiver.

The R820T

The R820T2 RTL-SDR is currently the cheapest, most common and the 'best' in terms of general usability although if you are looking for greater sensitivity and overall better performance, you might just have to spend a bit more. However, for £10 or so you can't really go wrong. The basic specification is a frequency range of 24 to 1766MHz with no gaps, a maximum sample rate of 2.4MS/s (mega-samples per second) and an output impedance of 75Ω.

My USB stick, **Fig. 1**, came from CosyCave and included an excellent variety of antenna connectors from F type to BNC male and female. However, there are plenty of other sources too and the photographs, **Figs. 2** and **3** show the internal construction of a couple of versions.

www.cosycave.co.uk/category.php?id_category=56

The Software

Sigmira™ is an SDR application that runs on the Windows operating system. Sigmira's features include (so the specification tells me):

- Waterfall and spectrograph displays of up to 200kHz bandwidth with the SDR-IQ™/SDR-14™. Display up to 2MHz bandwidth with the RTL-SDR.
- Demodulation of HFDL, PSK31, FSK, SITOR-B, CW and NFM modes.
- Demodulation of NATO STANAG 4285.
- Demodulation of the 'Japanese Navy Slot Machine'
- Point and click signal selection/tuning.
- Signal Database with automated tuning and logging.

- Phase plane display.
- Playback of saved .wav files.
- 16-bit sampling. Typical sampling rate: 48 kS/s.
- Signal strength meter.
- Adjustable squelch.
- RF gain control.
- Clock display with UTC and local time.
- Connection to on-line remote receivers.
- Frequency calibration facility

The distribution package includes examples of HFDL, PSK31, RTTY, FSK, SITOR-B, CW, NFM, JSM and STANAG 4285 signals in .wav files.

The latest version of Sigmira supports the RTL-SDR dongles. It is contained in the sigtools_1r13_installer. No updating of the features.dat file is required. Sigmira will do that automatically. Another bonus is that it's free.

I found the software somewhat quirky. For example, selecting the 'sound card' input option set my 'Line In' volume to OFF and blanked the display. Un-clicking this option in the Control Panel re-awakened the input. This happens every time the software is run and I have never managed to fix it.

Another quirk is that the software crashes randomly. It may be that my old Windows XP desktop running Windows 7 and Sigmira is being overworked a tad but, heh-ho, we can live with the occasional software crash.

Running in Windows 10 on a newer laptop gives no crashes.

Operation

The download link to the Sigmira Operations Manual is at the link below. Installation of the software, following the instructions in the manual, takes a few seconds and it runs in Windows XP, 7 and 10.

www.saharlow.com/technology/sigmira/sigmira_manual.pdf

Once loaded, the system requires some input, namely the input device. To familiarise yourself with the software, it's a good idea to select the 'sound card' option to use the 'example wave (*.wav)' as the input. Each mode requires a little fine tweaking to resolve the signals cleanly.

Plugging in and selecting the RTL_SDR dongle option as 'source' will pick up the USB receiver and start reception. Selection of frequency, mode, squelch and volume can all be achieved with a few mouse clicks.

Right-clicking a signal on the panorama display tunes to that frequency.

If the display stays blank, check that the sound 'input' is not disabled by looking in the Control Panel – Sound – Input – Level which may be 'OFF'. The screenshot, **Fig. 4**, shows where the sound card input adjustments are made.

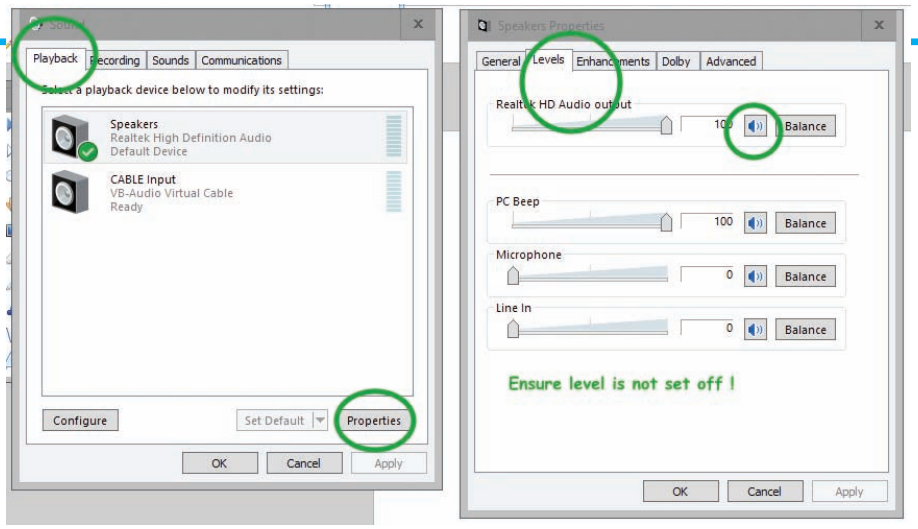

Fig. 4: Sound card adjustment screens.

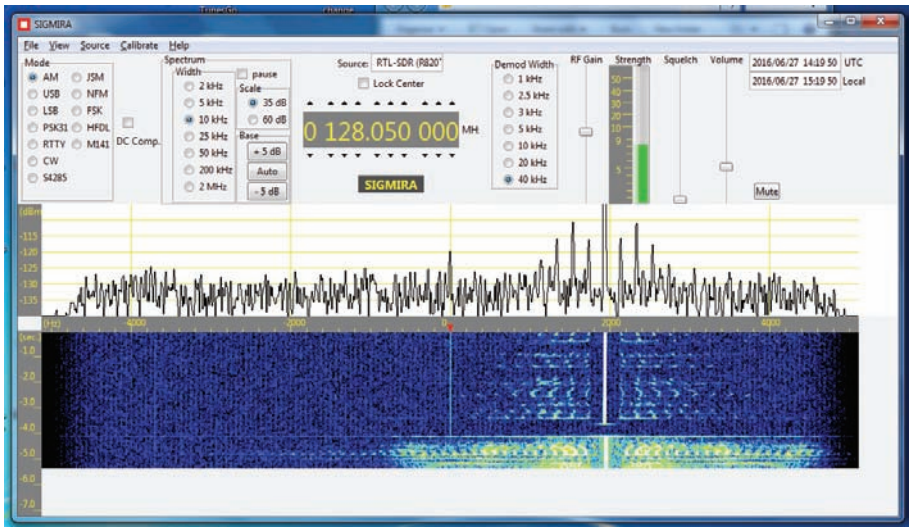

Fig. 5: The RTL dongle and Sigmira software receiving AM signals from air traffic control.

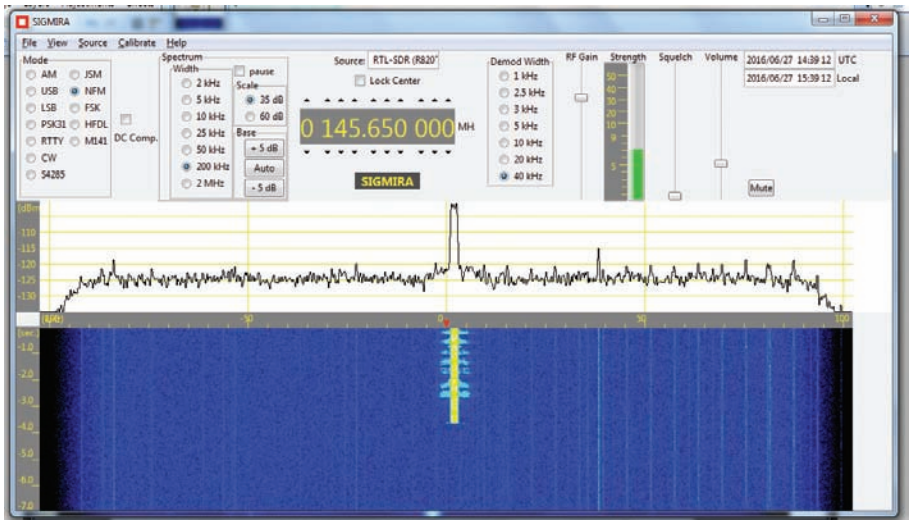

Fig. 6: Reception of an amateur radio FM signal on the 2m band.

Being able to 'see and hear' up to 2MHz in a panoramic display is very useful. Using only an amateur radio 144/430MHz dual-band antenna seems to give reasonable coverage from 75 to 750MHz. As a result, reception of VHF broadcast, air, marine bands, utility, weather satellite, DAB TV and VHF/UHF amateur bands is possible. I have even used the system to 'hear' and check the range of my weather station RF output on 868.3MHz. The screenshots, **Figs. 5**, **6** and **7**, show the

reception of AM, FM and CW signals.

If you want to try further afield, then the online connection option gives access to various receivers around the world. The supplied database, **Fig. 8**, works but there are many others options available such as the WebSDR network.

Further information about SDR generally and the RTL-SDR in particular can be found on the websites below. What's more, if you search for RTL-SDR on YouTube, you will find lots of videos about how to get started, how to decide various types of signal and so on.

https://en.wikipedia.org/wiki/Software-defined_radio

http://rtlsdr.org/

The Sigmira manual is very comprehensive and covers all areas of operation in great detail. It's certainly worth reading in some detail to find out just what you can do with that £10 – it's really quite remarkable.

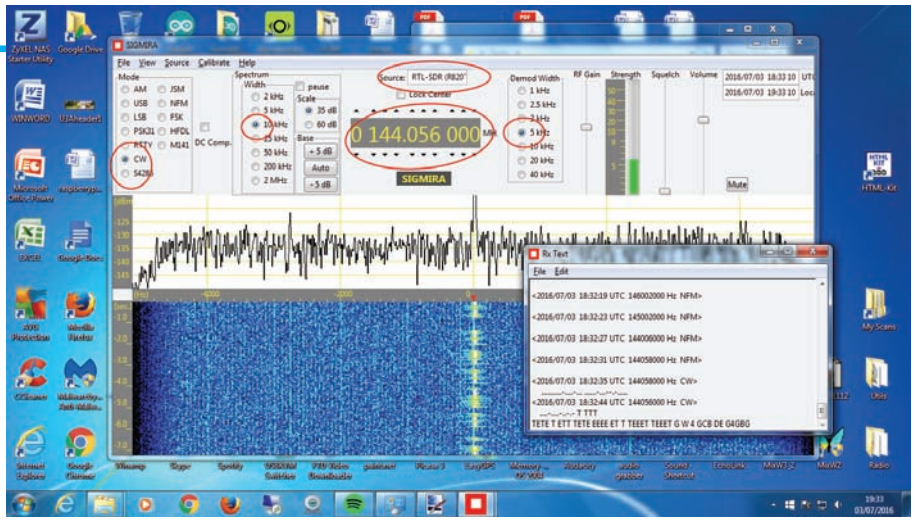

Fig. 7: Reception of a CW signal on the 2m band.

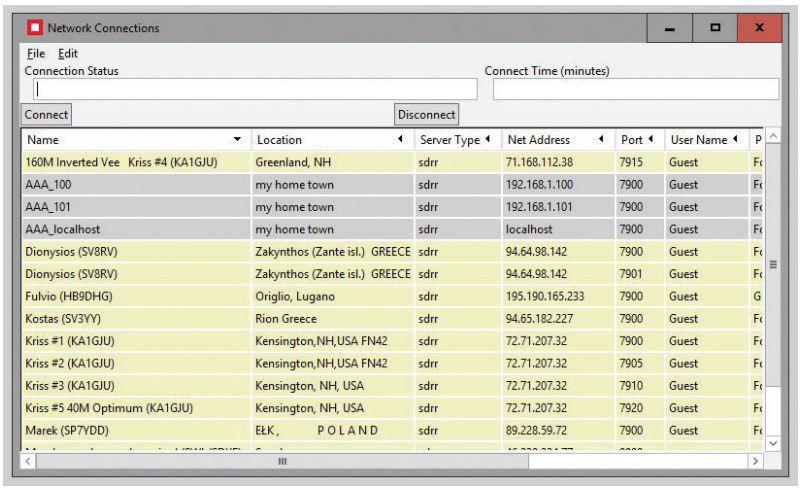
Network Connections
File Edit
Connection Status
Connect Time (minutes)
Connect
Disconnect
Name
Location
Server Type
Net Address
Port
User Name
160M Inverted Vee Kriss #4 (KA1GJU) Greenland, NH sdrr 71.168.112.38 7915 Guest
AAA_100 my home town sdrr 192.168.1.100 7900 Guest
AAA_101 my home town sdrr 192.168.1.101 7900 Guest
AAA_localhost my home town sdrr localhost 7900 Guest
Dionysios (SV8RV) Zakynthos (Zante isl.) GREECE sdrr 94.64.98.142 7900 Guest
Dionysios (SV8RV) Zakynthos (Zante isl.) GREECE sdrr 94.64.98.142 7901 Guest
Fulvio (HB9DHG) Origlio, Lugano sdrr 195.190.165.233 7900 Guest
Kostas (SV3YY) Rion Greece sdrr 94.65.182.227 7900 Guest
Kriss #1 (KA1GJU) Kensington,NH,USA FN42 sdrr 72.71.207.32 7900 Guest
Kriss #2 (KA1GJU) Kensington,NH,USA FN42 sdrr 72.71.207.32 7905 Guest
Kriss #3 (KA1GJU) Kensington, NH, USA sdrr 72.71.207.32 7910 Guest
Kriss #5 40M Optimum (KA1GJU) Kensington, NH, USA sdrr 72.71.207.32 7920 Guest
Marek (SP7YDD) EŁK, POLAND sdrr 89.228.59.72 7900 Guest

Fig. 8: The database of internet-connected SDR receivers around the world.

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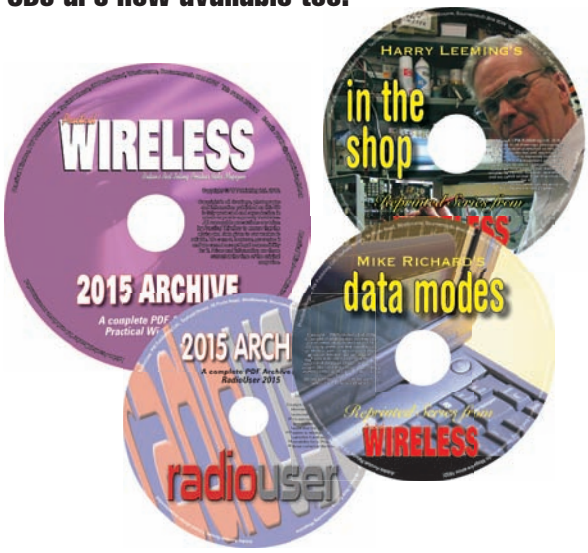
New In the Shop and Data Modes Archive CDs are now available too.



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